AS 3778.3.3—1990
ISO 1070:1973

Australian Standard®

Measurement of water flow in open channels

Part 3: Velocity-area methods Method 3.3: Measurement by slope-area method

This Australian Standard was prepared by Committee CE/24, Measurement of Water Flow in Open Channels and Closed Conduits. It was approved on behalf of the Council of Standards Australia on 9 April 1990 and published on 10 December 1990.

The following interests are represented on Committee CE/24:

Association of Consulting Engineers of Australia

Australian Water and Wastewater Association

Board of Works, Melbourne

Department of Water Resources, NSW

Engineering and Water Supply Department of South Australia

Forestry Commission, NSW

Institute of Instrumentation and Control

Monash University

Public Works Department, NSW

Snowy Mountains Engineering Corporation

University of New South Wales

University of Queensland

Water Authority of Western Australia

Water Board, Sydney

Water Resources Commission, Queensland

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PREFACE

This Standard was prepared by the Standards Australia Committee on Measurement of Water Flow in Open Channels and Closed Conduits. It is identical with and has been reproduced from ISO 1070 — 1973, *Liquid flow measurement In open channels — Slope-area method*.

This Standard is one of a series which deals with methods of measurement of water flow in open channels. The series when complete will consist of the following parts:

Part 1: Vocabulary and symbols
Part 2.1: General — Guidelines for the selection of methods of measurement
Part 2.2: General — Establishment and operation of a gauging station
Part 2.3: General — Determination of the stage-discharge relation
Part 2.4: General — Estimation of uncertainty of a flow-rate measurement
Part 2.5: General — Guidelines for the selection of flow gauging structures

Part 3: Velocity-area methods
Method 3.1: Measurement by current-meters and floats
Method 3.2: Measurement by moving-boat method
Method 3.3: Measurement by slope-area method (This Standard)
Method 3.4: Collection and processing of data for determination of errors in measurement
Method 3.5: Investigation of total error
Method 3.6: Measurement of flow in tidal channels
Method 3.7: Measurement by ultrasonic (acoustic) method
Method 3.8: Electromagnetic method using a full-channel-width coil

Part 4: Measurement structure methods
Method 4.1: Thin-plate weirs
Method 4.2: Rectangular broad-crested weirs
Method 4.3: Round-nose horizontal broad-crested weirs
Method 4.4: V-shaped broad-crested weirs
Method 4.5: Triangular profile weirs
Method 4.6: Flat-V weirs
Method 4.7: Rectangular, trapezoidal and U-shaped flumes
Method 4.8: Trapezoidal profile weirs
Method 4.9: Parshall and Saniiri flumes
Method 4.10: End-depth method for estimation of flow in rectangular channels with a free overfall
Method 4.11: End-depth method for estimation of flow in non-rectangular channels with a free overfall (approximate method)

Part 5: Dilution methods
Method 5.1: Constant-rate injection method for the measurement of steady flow
Method 5.2: Integration method for the measurement of steady flow

Part 6.1: Measuring devices, instruments and equipment — Rotating element current-meters
Part 6.2: Measuring devices, instruments and equipment — Direct depth sounding
Part 6.3: Measuring devices, instruments and equipment — Calibration of rotating element current-meters in straight open tanks
Part 6.4: Measuring devices, instruments and equipment — Echo sounders for water depth measurements
Part 6.5: Measuring devices, instruments and equipment — Water level measuring devices
Part 6.6: Measuring devices, instruments and equipment — Cableway system for stream gauging
Part 6.7: Measuring devices, instruments and equipment — Ultrasonic (acoustic) velocity meters
Part 6.8: Measuring devices, instruments and equipment — Position fixing equipment for hydrometric boats

For the purpose of this Australian Standard, the ISO text should be modified as follows:

(a) Wherever the words ‘International Standard’ appear, referring to this Standard, they should be read as ‘Australian Standard’.

(b) Wherever the word ‘fluid’ appears, it should be read as ‘water’.

(c) Substitute a point (.) for a comma (,) as a decimal marker.

(d) The references to other publications should be replaced by references to Australian Standards as follows.

Reference to International Standard		*Australian Standard*	
ISO		AS	
		3778	Measurement of water flow in open channels
772	Liquid flow measurement in open channels—Vocabulary and symbols	3778.1	Part 1: Vocabulary and symbols
1100/1	Liquid flow measurement in open channels—Part 1: Establishment and operation of a gauging station	3778.2.2	Part 2.2: General—Establishment and operation of a gauging station
1100/2	Liquid flow measurement in open channels—Part 2: Determination of the stage—discharge relation	3778.2.3	Part 2.3: General—Determination of the stage-discharge relation
748	Liquid flow measurement in open channels-Velocity-area methods	3778.3	Part 3: Velocity-area methods
		3778.3.1	Method 3.1: Measurement by current-meters and floats

Measurement of water flow in open channels

Part 3: Velocity-area methods
Method 3.3: Measurement by slope-area method

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the method of determining the slope and area of cross-section of the stream, and of computing the discharge therefrom. The method provides an approximate estimate of the discharge in somewhat special conditions in the stream and is used when estimation of discharge by more accurate methods, like the velocity-area methods, is not possible. The slope-area method can be used with some degree of accuracy in channels with stable boundaries such as rock (or very cohesive clay) bed and sides, and in channels with relatively coarse bed material; this method may also be used in other cases such as alluvial channels including channels with defined spills or non-uniform channel sections, subject to the acceptance of larger errors involved in the selection of the value of the Manning's coefficient *n* or Chezy's coefficient *C*. It is, however, not desirable to use this method in the case of very large channels or channels with very flat slopes of high sediment concentration or channels with significant curvature.

This International Standard deals only with ad hoc measurements of discharge and should not be employed for establishing rating-curves. Although the accuracy of results from applying the slope-area method is less than that from applying the velocity-area methods, it is sometimes necessary to use the slope-area method to define the extreme high-stage end of rating-curves because the magnitude of extremely rare floods is such that other methods of measuring discharge cannot be used.

2 REFERENCES

ISO 748, *Liquid flow measurement in open channels by velocity-area methods*.

ISO 772, *Liquid flow measurement in open channels — Vocabulary and symbols*.

ISO 1100, *Liquid flow measurement in open channels — Establishment and operation of a gauging-station and determination of the stage-discharge relation*.

3 DEFINITIONS

For the purpose of this International Standard, the definitions given in ISO 772 apply.

4 UNITS OF MEASUREMENT

The units of measurement used in this International Standard are seconds and metres (or feet).

5 PRINCIPLE OF THE METHOD OF MEASUREMENT

A measuring-reach is chosen for which the mean area of cross-section of the stream is determined and the surface slope of the flowing water in that reach is measured. The mean velocity is then established by using known empirical formulae which relate the velocity to the hydraulic mean depth, the surface slope corrected for kinetic energy of the flowing water and the characteristics of the bed and bed material. The discharge is computed as the product of the mean velocity and the mean area of cross-section of the stream.

6 SELECTION AND DEMARCATION OF SITE

6.1 Initial survey of site

It is desirable that approximate measurements of widths. depths and surface slopes should be made in a preliminary survey to decide on the suitability of a site conforming, as far as possible, with the conditions given in 6.2 and 6.3. It is intended that these measurements should only serve as a guide.

6.2 Selection of site

6.2.1 The accuracy of the determination of discharge by the slope-area method is increased if the river-banks and bed are reasonably stable and the river-reach fairly straight and uniform in section and free from obstructions and disturbances.

6.2.2 The length of the reach depends upon river slopes at very low stages and flood stages. The slope shall be such that the surface fall in the length of the reach used at each site is at least ten times the expected error in "measurement of fall".

6.2.3 The flow in the reach shall be free from significant disturbances due to the effect of tributaries joining upstream or downstream or of any structure. The reach shall be one in which no substantial expansion occurs.